

# Marder Group Policies on Lab Safety and Operations

*This document was updated on June 26, 2006.*

This document contains some safety information as well as policies for general operations for the Marder group. This document does **not** contain all information about safety. MSDS documents contain hazards about chemicals. Also, Georgia Tech and the School of Chemistry and Biochemistry have documents at <http://www.chemistry.gatech.edu/safety/index.php>.

You are required to read this document **and** the GT Environmental and Safety Manual and the Chemistry & Biochemistry Safety at the aforementioned website address. Then sign the last sheet of this document, returning it to Marsha within a week of receiving this document, or before you begin working laboratory work if you are new to the lab.

If you have any questions about anything in the document, ask Seth, Steve, Simon, Takashi, Neil, Susan, or Jon, the group safety officers. We will help you understand the policies if you have questions. We are also open to suggestions about the policies if you disagree with them.

Although certain members of the group are safety officers, it is everyone's responsibility to enforce safety rules if it is observed that someone is not following them. Don't forget what you have read here!

## **Preventing Chemical Contamination**

Do not type on a keyboard or use a mouse when you are wearing gloves. This includes instrument computers.

Do not wear both gloves outside of a laboratory. It is necessary to have at least one ungloved hand with which you can open doors. It doesn't matter if your gloves are completely clean. Other people don't know that, and we don't want to have to differentiate every time people wear gloves outside the lab. No gloves or lab coats are allowed in the office.

When you transport any chemical outside of a lab in a glass container, the bottle should be moved in a secondary container such as a rubber solvent carrier, acid-carrying bucket, or other appropriate container to protect against breakage and spillage. When they are transported on a wheeled cart, the cart should have wheels large enough to negotiate uneven surfaces without tipping or stopping suddenly, and the cart should have sides tall enough that if a bottle falls over, the bottle will stay inside the cart. If a container is too large for a solvent carrier, another non-glass container must be used to transport the chemical. People borrowing chemicals from our group must use a safety carrier to transport the chemical, whether or not that person thinks a safety carrier is necessary.

All chemicals and gas cylinders, empty or full, must be transported on freight elevators rather than the regular elevator.

Chemical spills should be cleaned up immediately unless injury or other hazards prevent immediate cleanup.

### **Use of Instruments**

All instruments have a logbook. Users should sign the logbook when they begin using an instrument and not waiting until they are finished. This is necessary because if you are not next to the instrument and someone wants to know who is currently using it, they can find out from the logbook.

If someone from another group uses the instrument, the person should include their advisor's name as well as their own.

When someone uses an instrument, one of the people in charge of the instrument should train the person how to use the instrument, even if the person has used a similar instrument. This is necessary so that the person in charge of the instrument can know that the person using the instrument has received appropriate instruction on how to use the instrument.

If there is a short instruction manual (compiled by a group member) for an instrument, you should read the manual if the person in charge of the instrument suggests it necessary or helpful.

### **People allowed in the lab**

People who are not trained as a research workers should not enter the laboratory unless wearing safety glasses (NOT just regular glasses) AND are accompanied by a research worker. There should be no exceptions here unless there has been an injury in the lab, and an administrator is the only available person. Note that this should not happen because students/scientists should not be working alone anyway.

### **Personal Safety**

Safety glasses must be worn by anyone entering the laboratory, whether or not the person is a member of our group. Ordinary vision-corrective lenses are not acceptable at any time.

Perforated or open-toed shoes are not permitted as appropriate lab attire. Sandals with socks are not appropriate. Shorts and skirts are not recommended.

Long hair should be tied back when in the lab, and loose clothing should be confined.

Wash all areas of skin potentially exposed to hazardous chemicals thoroughly prior to leaving the laboratory and immediately after handling hazardous chemicals.

Leave lab coats and other personal protective equipment in the laboratory when you leave. If lab coats need to be washed, place them in a plastic bag, take them home, and wash them separately from other clothing articles.

Avoid the use of contact lenses in the laboratory unless necessary. If they are used, tight-fitting goggles (not safety glasses) shall be worn at all times in the laboratory when there is a possibility of eye injury from chemical splashes or flying particles.

Keep the work area clean and uncluttered, with chemicals and equipment properly labeled and stored. Clean up the work area upon completion of an operation or at the end of a day.

All reactions and compounds should be labeled with your initials and lab notebook number. Vials of compounds should be labeled with a sticky label with transparent tape wrapped over the label. A label tied onto the bottle with a string is unacceptable.

Your lab notebook should be updated regularly, while you are doing / as soon as you have done an experiment. The lab notebook should be kept in the lab or the office

Appropriate gloves shall be worn when the potential for hand contact with hazardous chemicals exists. (A list of degrees of protection for various gloves is at the end of this document.)

Other personal protective equipment shall be used as appropriate to avoid hazardous chemical exposures and to prevent possible injury (e.g. face shield, chemical resistant coveralls, lab coat, chemical-resistant apron).

You should know the location of eye washes, safety showers, and fire extinguishers in any lab where you work.

Access to all safety and emergency equipment, exits, and laboratory exit paths shall remain unobstructed at all times. To keep exit paths clear, it is necessary to throw away trash boxes and empty solvent bottles when they are empty, rather than leaving them in the labs.

It is your responsibility to know the health hazards and necessary precautions that should be taken with the chemicals you are using. Reading MSDS (Materials Safety Data Sheets) will give information about a chemical's hazards, properties, and disposal. You can find MSDS website on Aldrich's website and on the Chematix website.

Skin contact with hazardous chemicals shall be avoided under all circumstances.

Do not directly smell or taste chemicals.

Do not ever eat, drink, smoke, chew gum or tobacco, store food or beverages, or apply cosmetics in areas where hazardous chemicals are used or stored.

Do not use glassware, containers, or utensils usually meant for the consumption of food or beverages in laboratory operations. Likewise, do not use items that are normally used for laboratory purposes to prepare, consume, or store food or beverages.

Do not use mouth suction for pipetting or starting a siphon.

Use a fume hood for operations that may result in the release of appreciable amounts of hazardous or odorous chemicals. Before using a hood, confirm that the hood has been certified. Also confirm that the hood is operational before use. Keep materials stored in fume hoods to a minimum, and do not allow them to block vents or air flow. Keep the hood sash closed as far as possible and completely closed when not using the hood.

The use of perchloric acid requires specially designed Perchloric Acid Fume Hoods. Since we do not have a hood designed for this operation, do not perform experiments with perchloric acid.

To avoid unnecessary exposure to solvent vapors, when possible, work with solvents should be done in the hoods. This includes running columns, preparing NMR samples, etc.

If you are using a chemical in the lab that requires you to wear a safety mask, all members working in that lab must be informed of your reason for wearing the mask and must be informed of the risks associated with the chemical so that they can leave the room if they think it is necessary. Also, a sign must be posted on each door leading into the lab so that people don't enter without knowing that a hazardous item is being used.

### **Working Alone and Unattended Operations**

No one is allowed to work alone. Someone should always be within shouting distance. If there is no one in your lab, it is required that someone in a nearby area check on you periodically and made aware that you are the only person in your lab. If no one else is in your lab, the door to your lab must be opened, and there must be people in neighboring labs who could hear you yell if necessary.

When setting up a reaction that requires the use of a reflux condenser, use clamps or wire around the joint where the tubing attaches to the reflux condenser, and if you are leaving the area, be sure that the water is draining properly into a sink and that the flow rate of the water is properly regulated.

If no one is in a lab, the door should be locked and closed.

When leaving the lab for the day, the lights should be turned off, the water faucets tightly fastened, the pumps and chillers turned off, and doors locked.

The lights in the chemical storage closets should be turned off if no one is inside. Keeping the lights turned off will help prevent decomposition of compounds that are light sensitive.

All reactions should have a label affixed to the reaction that has the experimenter's initials, his/her notebook number, and the page number of the reaction. Additionally, if a reaction is to be run unattended, a copy of the reaction contents and the risk assessment should be taped to the outside of the hood. The reason for this is so that if a reaction explodes, we can know from the outside of the hood what the reaction contents and chemical risks are, even if you are not here.

### **Chemical Storage**

All waste containers should be capped at all times, but it is advisable that they be capped somewhat loosely in case combinations of chemicals lead to gas production. This includes common waste containers as well as individual containers kept in hoods or in sinks.

All waste containers must be kept inside secondary containers. Waste containers must be clearly labeled as to their current contents. It should be obvious to anyone what the contents of a waste container are. Also, if a waste container is unique (meaning that it is not halogenated or nonhalogenated organic waste), then a waste label must be filled out as soon as the container is used for waste. If the contents of the waste container change over time, the label must be changed to reflect the current contents of the waste container.

Chemicals should not be stored in or under personal hoods (exceptions: heating/pump oils, the ammonium hydroxide under Susan's hood).

Chemicals should not be stored in round bottom flasks for long periods of time. It is unacceptable, for example, to have five round bottom flasks that contain compounds. If you do not know how to transfer an oil to a vial, ask someone (Simon, Susan, etc.)

Any 1 L or larger solvent bottles should not be kept outside of the solvent cabinets except for when they are being used. As soon as you are done, they should be returned to a solvent cabinet.

Flammable chemicals shall be handled only in areas free of ignition sources (this includes open flames, static electricity, burning tobacco[!], hot surfaces).

Flammable chemicals shall never be heated by using an open flame. Safer sources include steam baths, water baths, oil baths, heating mantles, and hot air baths (heat guns), although the filaments of heat guns can be a source of ignition of solvent vapors too.

An exhaust hood should be used whenever appreciable quantities of flammable chemicals are transferred from one container to another, when solvents are allowed to stand in open containers, are heated in open containers, or are handled in any other way.

The doors of solvent cabinets should be securely closed (and handles shut) when not being accessed to protect the contents from sources of ignition and fires in the cabinet isolated inside the cabinet.

### **Silica Gel**

Silica gel must only be dispensed in the two chemical storage closets. It is advisable that you wear a mask when dispensing silica gel in order to prevent possible silicosis. Silica gel must also be disposed of in the waste containers in the chemical storage closets. The silica gel may be wetted down with water to prevent dust from entering the air.

### **Waste and Trash Disposal**

Be aware of waste incompatibilities. There is a list of common chemicals that should not be mixed posted in each laboratory room. For example, do not combine ethanol and nitric acid in a waste container.

When a solvent or chemical bottle is empty, the solvent or chemical should be washed out of the bottle, and the residual solvent should be allowed to evaporate from the bottle in a hood. The chemical name should be crossed out with a permanent marker, and the bottle should be thrown away in the dumpster as soon as the solvent is evaporated. It is not okay to keep empty bottles around the lab or in hoods.

Broken glass, pipettes, glass TLC plates, and vials should be thrown away in a broken glass container. It is not necessary to throw anything away in a broken glass container that is not glass (paper towels, gloves, etc.). A broken glass container can be disposed of in the dumpster after being taped off.

Do not throw away un-broken bottles in the glass waste container. They should be thrown out separately in the dumpster outside.

When as few as one waste container is full, the waste pick-up should be called immediately, and a waste label should be filled out and pasted to the waste container.

Needles and razors should be disposed of in a sharps container.

Only neutralized aqueous waste free of organics and free of hazardous inorganic compounds may be put down the sink.

Waste containers should always be labeled as to their current content.

Suitable labels for waste containers do not include merely “organic waste,” “aqueous waste,” or “solid waste.” Specific chemical information should be given for the contents of waste containers such as acetone, hydrochloric acid, or silica gel.

### **Gas Cylinders: Use of Compressed Gases**

Gas cylinders should be securely tied to something before the cap is removed. Under no circumstances should an uncapped cylinder, with or without a regulator, be unchained or moved. Each uncapped cylinder in use should have its own chain, i.e. it should not be “gang chained” with other cylinders.

If you are transporting a cylinder, whether it is empty or full, the cap should be securely fastened around the top.

When a gas cylinder is emptied, it should immediately be taken to the stock room’s cylinder storage area unless the stock room is closed. If the stock room is closed, the gas cylinder should be stored securely upright in the cylinder area with a label that includes the person’s name who is responsible for the empty cylinder as well as the date the cylinder became empty and should be taken down to the basement as soon as possible.

### **Reactions under Pressure**

Reactions carried out in closed vessels (i.e. without access to the lab / hood atmosphere, either directly or through a bubbler) are potentially extremely dangerous. The lab worker should first calculate the possible pressure generated in the vessel at the reaction temperature, assuming that each component can independently exert its vapor pressure at that temperature and that that vapor pressure can be estimated from the ideal gas law. In addition, the possibility for the generation of pressure from all possible side products should be considered. If you are unsure how to estimate the pressure that might be generated, please ask.

The total possible pressure should fall well short of the maximum pressure rating of the vessel being used, or a pressure sensor should be used (as on the microwave reactor) that will stop the reaction if the pressure gets too high.

All sealed vessel reactions should be carried out in the hood with the doors fully closed and with a label clearly indicating the hood contains a reaction under pressure.

## **Risk Assessments**

For every experiment you perform, you need to fill out a risk assessment and plan. For the risk assessment, you should list every chemical you will come in contact with during the experiment (this includes chemicals involved in reaction workups including drying agents, chromatography solvents and solid phases, washing solutions, etc.) Then you should either access the MSDS to find the hazards of the material you are using (you can access MSDSs using the Chematix website), or you can look in the Aldrich catalogue, which gives numbers for each chemical that correspond to safety hazards in a list in the front of the catalogue. Aldrich's lists tend to be a little less thorough than the complete MSDS; for example, for some palladium catalysts, no risks are listed in the Aldrich risks whereas they do have hazards listed in MSDSs.

In addition to assessing chemical hazards, you should also list other dangers that are related to the reaction itself. For example, if you are performing a Grignard reaction, extra care should be taken in cooling because of the reaction's tendency to be unpredictably exothermic. In another example, if you are doing a reaction in a closed system, an additional risk is the potential pressure buildup in the flask, which should be calculated (see a separate section on calculating pressures), and you need to address this potential danger in your assessment. Also take into consideration the risks of the products. For example, is a gas generated? You should make an intelligent assessment of the risks of the organic products. If the compound you are making is not known, you should try to find similar compounds and make an educated risk assessment based on the closest known analogues.

Finally, you need to write a general reaction plan, which should include descriptions including things like the reaction vessel, temperatures used, atmospheres, the order of adding reagents, the method of monitoring the reaction, how a work-up will be performed, and anticipated methods of handling and purifying the desired product.

When you have filled out your risk assessment and plan, Simon or Steve should look over the risks and plan to see if you have properly taken risks into account and that your plan seems reasonable. If you are a postdoc, it is required that you fill out this plan, but it is not required that you get it approved (although you are welcome to get your plan approved and are encouraged to ask Simon and Steve and others around the lab for input). If you are a graduate, undergraduate, or high school student, you must get any new plan approved. If Simon and Steve are not around, you may ask a senior postdoc or Seth to look at your risks and plan.

## Chemical Resistance of Common Glove Material

S: Superior, E: Excellent, G: Good, F: Fair, NR: Not recommended

<b>Chemical Resistance</b>	<b>Neoprene</b>	<b>Vinyl Plastic</b>	<b>Rubber Latex</b>	<b>Nitrile</b>	<b>Syn-Latex</b>	<b>Natural Latex</b>
alcohols	E	E	G	E	E	G
caustics	E	E	E	E	E	E
chlorinated solvents	G	F	NR	E	G	NR
ketones	G	NR	G	G	G	G
petroleum solvents	E	G	F	S	E	F
organic acids	E	E	E	E	E	E
inorganic acids	E	E	E	E	E	E
non-chlorinated solvents	G	F	NR	G	G	NR
insecticides	E	E	F	S	E	F
inks	E	E	F	S	E	F
formaldehyde	E	E	E	S	S	E
acrylonitrile	E	G	E	S	E	E
hydraulic fluid	E	E	F	S	E	F
carbon disulfide	NR	F	G	F	NR	G
paint remover	R	F	NR	E	F	NR

I have read and understood the Marder Group Policy on Lab Safety and Operations document.

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Printed Name

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Signed Name

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Date